(No Model.)

F. R. McBERTY.

TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS.

No. 509,932. Patented Dec. 5, 1893.

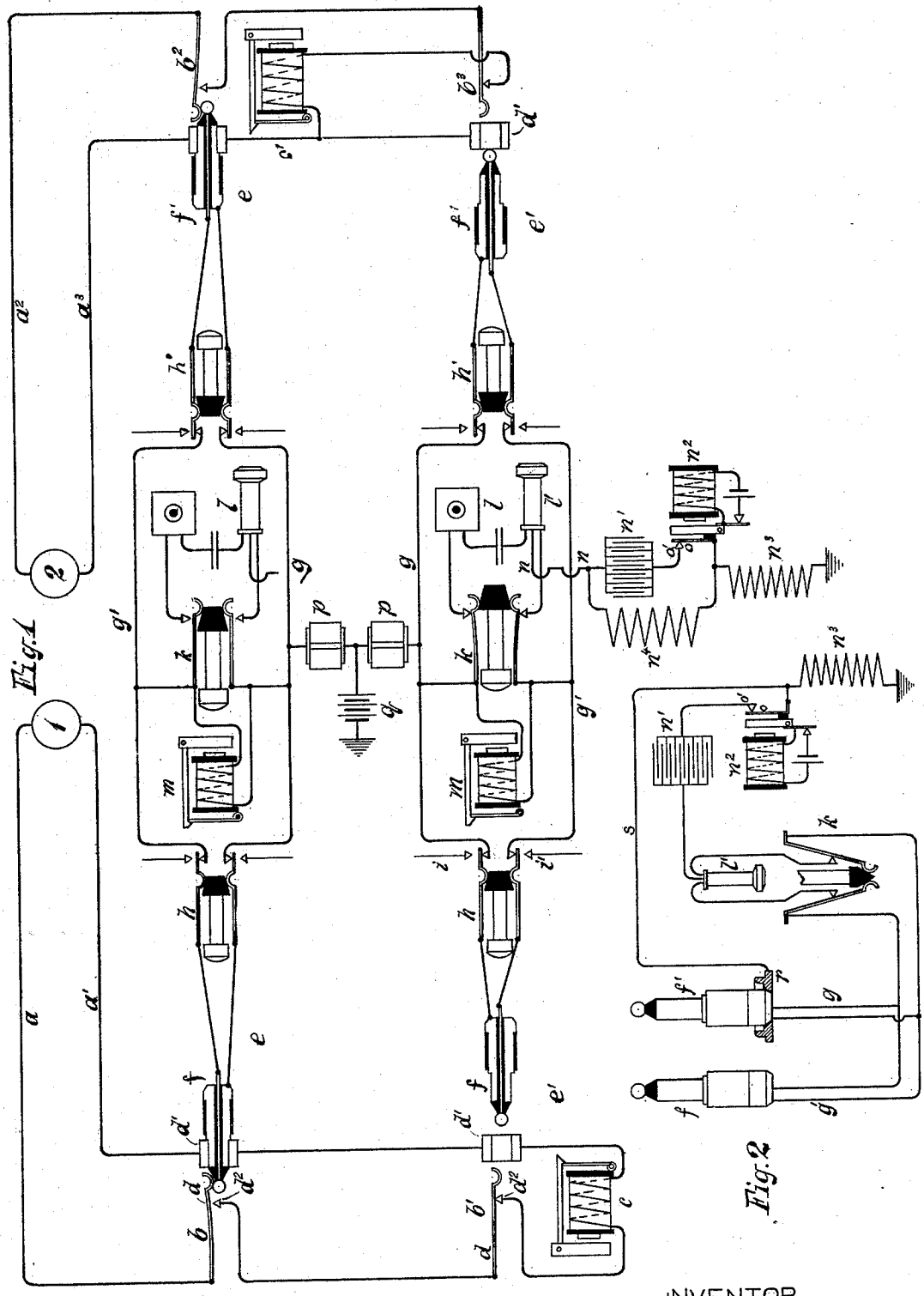

Fig. 1

Fig. 2

WITNESSES
Ella Esler
Lucile Russell

INVENTOR
Frank R. McBerty

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANK R. McBERTY, OF DOWNER'S GROVE, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS.

TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 509,932, dated December 5, 1893.

Application filed February 7, 1893. Serial No. 461,413. (No model.)

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Downer's Grove, in the county of Du Page and State of Illinois, have invented a certain new and useful Improvement in Testing Apparatus for Multiple Switchboards, (Case No. 5,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to testing apparatus for multiple switchboards of telephone exchange central stations.

As is well known in the art, central stations of exchange systems comprising a large number of telephone lines are provided with switchboards whereby any line may be connected with any other line. The switchboard is commonly divided into a number of sections upon each of which are disposed the annunciators of a certain number of subscribers, each group of annunciators being under the care of an attendant operator; in order that any operator may make connection between any two lines at her own section of the multiple switchboard, spring-jacks or terminal sockets, one for each line connected with its particular line, are provided upon each section of the switchboard. It is necessary, however, that an operator at one section of the switchboard shall be able to determine whether or not any required telephone line is already in use or connected at some other section of the switchboard. The device whereby an operator is thus enabled to determine whether any line is in use or not is commonly known as the test system. Ordinarily, in multiple switchboards for exchanges having metallic circuit lines, or comprising both metallic circuit and grounded lines, the test system consists of a grounded battery or other source of electric current connected with the loop plugs whereby connection is established with a line, and adapted to be crossed with one of the contact pieces of the springjack into which the plug may be inserted, and a grounded testing plug adapted to be applied to the corresponding contact piece of any springjack, the testing plug including in its branch circuit a telephone or other responsive device. Thus when connection is made with any line, certain contact pieces of all the springjacks of that line are electrified to a difference of potential from the earth, and whenever the grounded test plug is applied, in testing, to that contact piece, a current is created through the telephone or other responsive device which indicates to the operator making the test that the line tested is already in use. Most commonly, the responsive device employed is the operator's telephone receiver, the response being a click in the telephone. Telephone lines are, however, subject to external electrical influences which induce currents or static charges upon them; such currents or charges escaping to earth through the test circuit cause false clicks and signals in the responsive device and give rise to confusion in the operation of switching.

It is the object of my invention to provide a test signal of a character distinct and different from any click or similar sound which might be caused by the discharge of a static charge upon the lines, the test signal being at the same time of only momentary duration. Attempts have heretofore been made to produce such individualized or characteristic test signals, usually as a musical tone. It is desirable that the signal be of very short duration in order that it may not be required that the device producing the signal shall be disconnected so as to prevent interference with the operator's telephonic apparatus. This has been accomplished heretofore by mechanical devices which have required comparatively strong currents for their operation, and have been slow and unreliable in their responses.

My invention consists of a condenser, a resistance, and a vibrating circuit breaker or rheotome in the test circuit, and means for occasionally or continuously discharging the condenser.

In the operation of testing, the condenser is charged by the intermittent testing current, the time of charging being made comparatively long by the inclusion of the resistance in the test circuit; whereby, during the flow of the charging current, a musical tone is produced in the telephone in the circuit. The test signal is thus rendered characteristic and individualized, and at the same time

limited to short duration without the employment or intervention of mechanical devices. In order to discharge the condenser after each test signal, I preferably place a coil of high resistance and self-induction in shunt about the condenser, through which the discharge of the condenser continuously takes place. It will be understood that the charging of the condenser is not prevented by this coil, since the condenser is charged to the difference of potential which is set up between the terminals of the high resistance shunt. The resistance coil is preferably arranged as a shunt about both the condenser and the vibrating circuit breaker, in order that continuous currents, escaping through the high resistance shunt, may not produce a sound in the telephone.

I have sometimes employed a different device for discharging the condenser, consisting of contact points adapted to be closed together by the test plug when out of use, and when closed together, to short circuit the condenser; thus when the testing plug was raised to make a test, the condenser was put into condition to receive the charge.

I have illustrated my invention in the accompanying drawings, Figures 1 and 2.

In Fig. 1 I have shown two substations, each connected by a metallic circuit with an annunciator and springjack switches at a central office, the annunciators and springjacks being supposed to be located upon different switchboards, the usual connecting apparatus, and my improved testing apparatus having means for continuously discharging the condenser. Fig. 2 represents the mechanism for use in connection with the testing plug to discharge or short circuit the condenser while the plug is out of use.

Referring to Fig. 1 of the drawings, the substations 1 and 2 are supposed to be equipped with the ordinary substation apparatus in common use in telephone exchange systems. The apparatus—at substation 1 for example—is connected by lines a a' with springjacks b b' at the central office and also with an individual annunciator c thereat. The springjacks b and b' are of ordinary construction, each having a line spring d and a test ring d' connected with the different sides a and a' of the line circuit, respectively, a normal resting contact d^2 being arranged for the spring d through which the line circuit extends to the next jack. The resting contact d^2 of the last springjack of the series is connected with one terminal of the annunciator c, so that the latter is disconnected whenever a plug is inserted into any springjack thereby raising the line spring of that jack from its normal resting contact. The springjacks b and b^2 of lines 1 and 2 are supposed to be located upon one section e of multiple switchboard, and the springjacks b' and b^3 to be located upon another section e' of the switchboard, their respective annunciators c and c' being located upon the different boards, in order that the annunciators may be under the care of different operators.

The appliances provided for the use of the operator in placing two lines in communication are also of the usual and well known character. Pairs of connecting plugs f and f' are provided, each plug consisting of two parts insulated from each other, one being arranged to connect with the line spring d and the other with the test ring d' of a springjack into which it may be inserted; the different parts of the two plugs of a pair are connected by electrical conductors g and g'. In the conductors g g' are included two ringing keys h and h', either of which is adapted, when depressed, to disconnect one of the plugs from the other and to connect its different portions to the terminals i and i' of a calling generator, not shown. The contact springs of a listening key k are connected with each cord circuit g g', the corresponding contact anvils constituting the terminals of the operator's telephone set l, whereby the telephone set may be connected in a bridge between the different sides of the circuit in order that the operator may communicate with the subscribers with whose lines the cord circuit is connected. A clearing-out annunciator m is also included in a permanent bridge connection between the conductors g g' to receive the signals for disconnection upon the completion of conversation.

A ground connection is extended from the center of the coil of the operator's telephone receiver l' to earth in the usual manner. In my invention I include in this ground branch a condenser and a device for rendering the current through it undulatory or intermittent, as a vibrating circuit breaker or rheotome.

In the branch n from the telephone l' to earth is shown included a condenser n' and the contact points o and o' of a vibrating circuit breaker n^2. The condenser n' may be of one microfarad capacity, or more, as desired, the duration of the tone depending upon the capacity of the condenser and the resistance of the circuit. To prevent the too rapid charging of the condenser n' I include a resistance n^3 in the circuit; the resistance may be one thousand ohms, or more, if desired. To accomplish the discharge of the condenser n', a resistance coil n^4 is placed in shunt thereof; this coil n^4 may be of ten thousand ohms resistance and may, with advantage, have considerable inductance to impede the passage of telephonic or rapidly undulating currents through it.

The different operations of signaling from the substation to the central station, and connecting lines, and testing to determine whether the lines are already in use or not, are all well known and are described in numerous patents; hence I will trace these operations only very briefly, and will pay especial attention to my improvement in the testing apparatus and to its operation. A sub-

scriber, desiring to converse with another subscriber of the exchange system, sends a signal to the central station by rotating the armature of his generator, as usual, suppose, for example, that subscriber at station 2 desires connection with substation 1; the signaling current thus sent finds circuit over lines a^2 a^3 to the central office and through individual annunciator c' thereat, operating the annunciator and indicating the signal to the attendant at switchboard e. The operator at this switchboard then inserts one plug of a pair into the springjack b^2 of that line at her board, and depresses her listening key k, whereby her telephone set l is connected with the line circuit a^2 a^3, and she is enabled to receive the order from subscriber at station 2; she then tests the springjack b of line to station 1 at her board to determine whether that line is already in use or not at the section e of the switchboard. I will not, at present, follow this operation of testing, but will revert to it in connection with my improvement a little later. Assume, however, that she finds the line to station 1 not in use; she then inserts the plug, with which she has made the test, fully into the springjack of the line desired. The substations 1 and 2 are shown thus connected by means of the cord circuit at switchboard e. Having established connection with line to station 1, the operator depresses her calling key h, thereby looping the calling generator into the line circuit in the usual manner to send a call signal to the substation. When the called subscriber has responded to the signal and removed his telephone from its switch hook, the subscribers at the substations are in communication. Having satisfied herself that the connection has been properly made, the operator allows the plunger of her listening key k to rise, thus disconnecting her telephone set from the line circuit. When the subscribers have completed their conversation, either of them may operate his calling generator, and the signaling current therefrom will find circuit to the cord circuit g g' and thence through the clearing-out annunciator, which will be operated and will indicate the signal for disconnection to the attendant, who will proceed to remove the connecting plugs from the springjacks of the lines, and will thus restore the lines to their normal condition.

I will now describe the apparatus and the mode of testing at any switchboard to determine whether a line called for is already in use or not at some other switchboard. The test rings or pieces d' of the different springjacks of each line are connected together throughout the central station, and are normally insulated from the earth. If an operator should apply the tip of a testing plug to the test ring, as the plug f' is shown applied to the test ring of springjack b^3 at board e', her telephone l' would be included in a branch circuit from the test ring through one contact spring of the listening key k to the telephone, through one half of the coil thereof, to earth branch n, thence through the condenser n' and the resistance n^4 in parallel, to the resistance n^3, and thence through the latter to earth. This circuit, however, does not contain any source of current, and hence no response is produced in the telephone receiver l' when an idle line is tested. But when a connecting plug is inserted into a springjack of the line, the sleeve of the plug, which is connected by way of the conductor g, retardation coil p, and battery q to earth, makes contact with the test ring of the springjack and thus causes the entire series of test rings to be electrified to a difference of potential from the earth. When, now, a test ring of this line is touched with a testing plug, as plug f', a current escapes through the circuit before traced including the operator's telephone l'. During the first moment of contact between the plug f' and the test ring, the current flows directly into the condenser n', through the vibrating contacts o o' and the resistance n^3 to earth; an undulatory current thus traverses the telephone l' and produces a musical tone therein. In a moment, however, the condenser n' becomes fully charged and the current ceases to flow through the branch including the condenser and the contacts o o', and the musical tone in the telephone l' disappears. A slight current may continue to flow through the resistance coil n^4 to earth, but this current will be of continuous character and will produce no sound in the telephone l'. There is thus produced in the telephone l' a musical tone which is loudest at its inception and which rapidly fades or decreases to silence. The duration of the tone obviously depends upon the length of time required by the condenser n' to become fully charged, and hence may be increased by increasing the capacity of the condenser or the resistance n^3. I find a capacity of one microfarad to be sufficient for the condenser n', and a resistance of from one thousand to five thousand ohms to be sufficient for the coil n^3. The moment the test plug f' is withdrawn from contact with the test ring d', the condenser n' begins to discharge through the resistance coil n^4, and the discharge is very soon complete. The testing plug f' may thus be quickly tapped upon the test ring d', or upon different test rings in quick succession, and at each application a musical tone, lasting a fraction of a second, is produced in the telephone l'.

In Fig. 2 I have shown a different appliance for discharging condenser n'. In this figure a portion of one of the operator's outfits is shown, comprising the two connecting plugs f f', the conductors g g' joining the different contact pieces of the plugs, the listening key k, the operator's telephone l' adapted to be connected with conductors g g' by means thereof, and the condenser n', rheotome n^2 and resistance n^3 in a ground branch from the

center of the telephone. In this modification, a contact piece or plate r is provided upn which the testing plug f' normally rests, and with which the sleeve thereof makes electrical contact. This piece r is connected by a wire s with the ground branch n in such a manner that when the apparatus is in the position shown, wire s completes a shunt about the condenser n'; thus, in the figure, the circuit may be traced from one side of condenser n' through the rheotome contacts o o' to the wire s, thence to the piece r, the sleeve of plug f', to the conductor g and thence to the corresponding contact spring of the key k, thence through one-half of the telephone l' to the other side of the condenser; hence, as long as the testing plug f' remains idle or not in use, and the key k is in position to connect the telephone with that cord circuit, the condenser is permitted to discharge through the circuit thus formed; but when the operator raises the plug f' from its socket to make a test, the short circuit about the condenser n' is automatically broken and the condenser is in condition to produce a momentary test signal in the manner before described.

It will be understood that a single condenser n' and rheotome n^2 are provided for each operator, since the testing apparatus is connected only with the pair of plugs which the operator may be using at any particular moment.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The method of producing a tone of momentary duration in a telephone without mechanically opening the circuit, which consists in charging a condenser in a circuit including the telephone by means of a direct current of an undulatory or pulsatory character, substantially as described.

2. The combination in a normally discontinuous test circuit including a source of electromotive force, of a condenser, a telephone, a device adapted to render the current through it pulsatory or alternating, and means for closing the said test circuit, whereby when said circuit is closed a tone of short duration is produced in said telephone, substantially as described.

3. The combination in a normally discontinuous test circuit including a source of electromotive force, of a condenser, a telephone and a device for rendering current through it pulsatory or undulatory in character included in said circuit, a shunt circuit about said condenser, and means for closing said test circuit, substantially as described.

4. The combination with a test circuit for multiple switchboards, normally discontinuous at two points, of a source of electromotive force in said circuit, a condenser, a telephone and a device for rendering current through it of pulsatory or undulatory character, a shunt circuit of high resistance about said condenser, and means for closing said circuit at each of its points of normal discontinuity, substantially as described.

In witness whereof I hereunto subscribe my name this 17th day of November, A. D. 1892.

FRANK R. McBERTY.

Witnesses:
ELLA EDLER,
LUCILE RUSSELL.